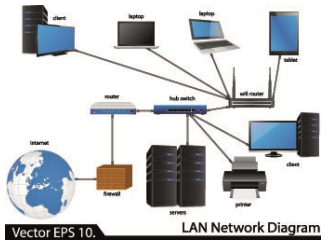
What Are Networks?
- an Overview

What is a network?

- System that connects two or more devices over some distance
  - Computers
  - Cell phones
  - Computer periperhals (keyboards, mice, headphones…)
- Local Area Networks (LANs) typically operate over a few hundred meters
- Wide Area Networks (WANs) operate over country-sized distances

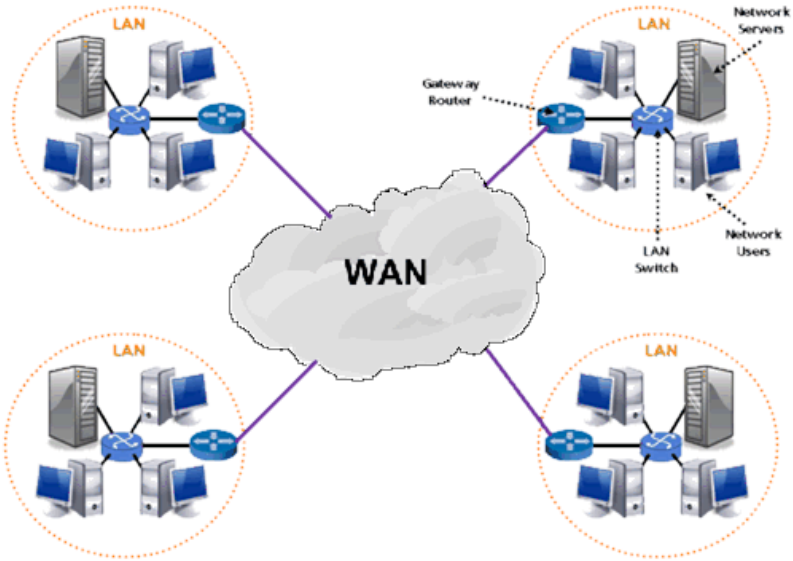
LANs versus WANs

- LAN
  - consistent, overall rules for operation
  - managed by a single, local authority
  - much focus on underlying hardware



- WAN
  - separate pieces, operating separately
    - pieces are typically LANs
  - pieces may all be owned by one large company, or may be independent
  - negotiation, cooperation between the operators of the pieces

An example WAN

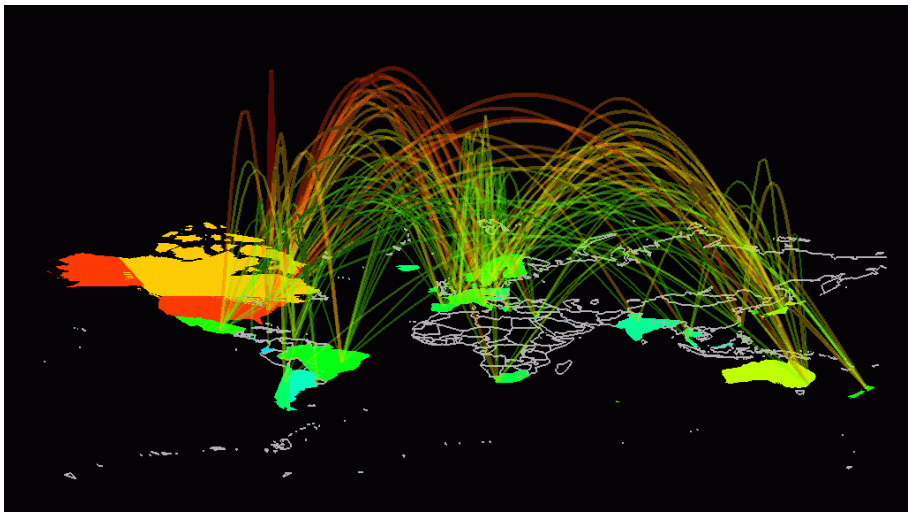


What is the Internet?

- The premier WAN, operates globally
- Connects many smaller, independent LANs to each other
- Connective hardware and software is operated by ISPs (Internet Service Providers)
- Serves as a role model for private / corporate WANs
  - often called "Intranets"

The Internet

It's hard to envision the Internet. Here's one attempt:



Parts of the Internet

an attempt to depict the Internet's "autonomous systems"

What is "the Web"?

- *a.k.a.* the World Wide Web (WWW)
- A collection of procedures for sharing information over the Internet
  - text, graphics, multimedia…
- User-oriented, not concerned with underlying hardware
- Many people only see the Internet in terms of the Web
  - but they're distinct!

Territories of the Web

Rules and procedures for operating networks

- Known as *protocols*
- Specify hardware, software, patterns for interaction
- Proprietary protocols: developed and controlled by one company (e.g., Cisco)
- Open Standard protocols: developed by consensus between users and providers
  - allow different companies to make compatible equipment and software

LAN protocols

- Detailed specifications for the hardware needed to connect devices
  - Devices collectively known as *nodes*
- Supporting rules for using the hardware
- Today, the dominant LAN protocols are the **Ethernet** family

WAN protocols

- Rules for interconnecting LANs
- Generally independent of hardware choices
- Many parts, aimed at making interconnections easier for users to navigate
- Almost everybody uses **Internet Protocols** (**IP**) for their WANs
  - and their LANs

IP protocols

- Many separate parts:
- **TCP**, **IP**, **UDP** – basic data transmission
- **DHCP** – configure devices to successfully operate as Internet *hosts*
- **DNS** – convert human-friendly names into Internet addresses
  - e.g. "bloomu.edu" → 148.137.10.10
- **SMTP**, **HTTP**, **FTP**, … – rules for user applications
  - email, the Web, file transfers, etc.

Organizing the protocols

- Networks are complex systems, requiring many cooperating protocols
- *Protocol stacks* are packages of interacting protocols that make a LAN or WAN work
- *Models* provide frameworks to put interacting protocols together so that we can understand what's going on

Protocol Models

- **OSI** – Open Systems Interconnection
- authoritative attempt to categorize network operations
- Excessively detailed for actual use

- **TCP / IP**
  - Transmission Control Protocol / Internet Protocol
- formalized description of the protocols used on the Internet
- Less detailed than OSI, but it represents how the Internet is actually implemented

Protocol Stacks

- Interacting sets of actual protocols
- TCP/IP *protocol stack* is described by the TCP/IP *model*
- Smaller stacks provide specific functions
- No current protocol stack follows the OSI model exactly
  - it's too complex and theoretical